

# The Disease Impact Assessment System (DIAS)

A Spreadsheet for Estimating the Impact of Nine Chronic Diseases and Associated Risk Factors in Communities

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A core function of public health agencies at all levels of government is the assessment of the health status of communities (1). This assessment helps to focus prevention programs on the highest priority health issues. Since budgets are generally limited, priorities have to be set to choose the "best" prevention strategies (2). In public health, "best" is usually conceived as some measure of cost-effectiveness and, thus, measures of the disease impact on the population's health status must be taken in order to decide which interventions to implement.

Unfortunately, the impact of chronic diseases is difficult to summarize concisely in terms of the global burden experienced by a population at any given time. The impact should be described in several dimensions, including the monetary cost to society and the overall loss of physical, social, and psychological functions experienced by the population. Measures such as these are, by their nature, extremely difficult to obtain in a reliable manner and on a routine basis.

At the State level, multiple sources of data often exist to assess the disease burden on the population, including mortality, cancer incidence, hospital discharge diagnoses, or

behavioral risk factor survey data (3). In contrast, it is often difficult for the staffs of local public health agencies to perform these assessments, either because the data are difficult to obtain or because they do not exist at the local level.

In this report, we describe a simple method to estimate the burden and preventability of nine major chronic diseases in a community. These nine diseases were chosen in conjunction with the Centers for Disease Control and Prevention (CDC) of the Public Health Service as a starting point. The system, entitled the "Disease Impact Assessment System" (DIAS) is a Lotus-1-2-3-based microcomputer program that brings together in one system basic information on the chronic disease burden, such as mortality, morbidity, and economic cost measures. If actual data are not available, DIAS provides estimates that can be used as a starting point for assessing the health status of communities. If actual data are available, DIAS draws on national estimates that can be helpful in the investigation of local differences.

## Conceptual Framework

Defining "chronic disease" is difficult, since no etiologic cornerstone (such as an infectious agent) exists on which to build a definition (4). Nevertheless, generally included in such a definition are attributes such as uncertain etiology, long induction period, long period of clinical manifestations, high clinical threshold, prolonged clinical course, no known cure, and debilitating manifestations (5).

The causes of chronic diseases are diverse and, to a large extent, related to individual lifestyle and environmental factors. These causes can be thought of as risk factors and include such habits as smoking, improper diet, and physical inactivity. Persons who engage in these behaviors may, in turn, develop conditions such as high blood pressure, high blood cholesterol, or

diabetes. People with these conditions are at increased risk for developing diseases such as heart disease or cancer. The relationship among risk factors, conditions, and chronic diseases is complicated. Furthermore, whether or not a person with risk factors will develop a condition or a chronic disease depends on other aspects, such as their own characteristics or those of their environment.

People who develop chronic diseases will eventually make use of the health care system. In addition, the ultimate impact of such diseases can be looked at in terms of changes in physical, social, and emotional functioning and in terms of health status, quality of life, and life expectancy. This chronic disease spectrum, ranging from a person in a given environment to health outcomes and ultimately death, is depicted in the chart. The diagram constitutes the conceptual framework within which DIAS was developed to analyze the impact of chronic diseases at a population level. The system attempts to capture limited individual characteristics, most known risk factors, and physiological conditions related to nine chronic diseases. This information is used to estimate the impact of these diseases in terms of several dimensions covering morbidity, use of health care, and mortality.

## Measures and Available Data

The conceptual framework in the chart emphasizes that the burden of chronic disease is both complex and multidimensional. Nevertheless, given limited resources, decisions have to be made regarding prevention or treatment strategies, or both. Thus, the priorities for allocation should be assigned according to an assessment of the magnitude of a given health problem and the potential for improvement, relative to other health problems and potential interventions competing for the same resources.

# INFORMATION TECHNOLOGY

At present, the assessment of the impact or burden of a specific disease on a population is generally expressed in one of various dimensions to highlight the nature of the disease. For example, the number of deaths per 100,000 people is a clear expression of the burden of a disease that results in sudden or relatively sudden death. Acute infectious diseases that do not result in death and run a brief course often are expressed adequately as simple incidence rates. Many chronic diseases, however, result in lingering disability that may not lead to death for a number of years. The simple expression of the disease burden as an incidence or mortality rate does not provide a complete picture of the impact of these diseases. To gain a better image of disease burden, it may be appropriate to give some account of the degree of disability and amount of health care use a given disease puts on

an individual and society.

Three general areas of concern make up the concept of burden of a chronic disease: (a) morbidity concerns (persistence-recurrence over time, likelihood of short-term and long-term disability, quality of life, associated direct and indirect morbidity costs, and so forth); (b) mortality concerns (likelihood of decreased life expectancy short term and long term, and associated direct and indirect mortality costs; and (c) health system utilization concerns (expected need to perform diagnostic or therapeutic procedures, expected cost of associated diagnostic or therapeutic procedures, likelihood of return visit for that condition, likelihood that specialty services will be required, likelihood of hospitalization, and associated direct health care expenditures).

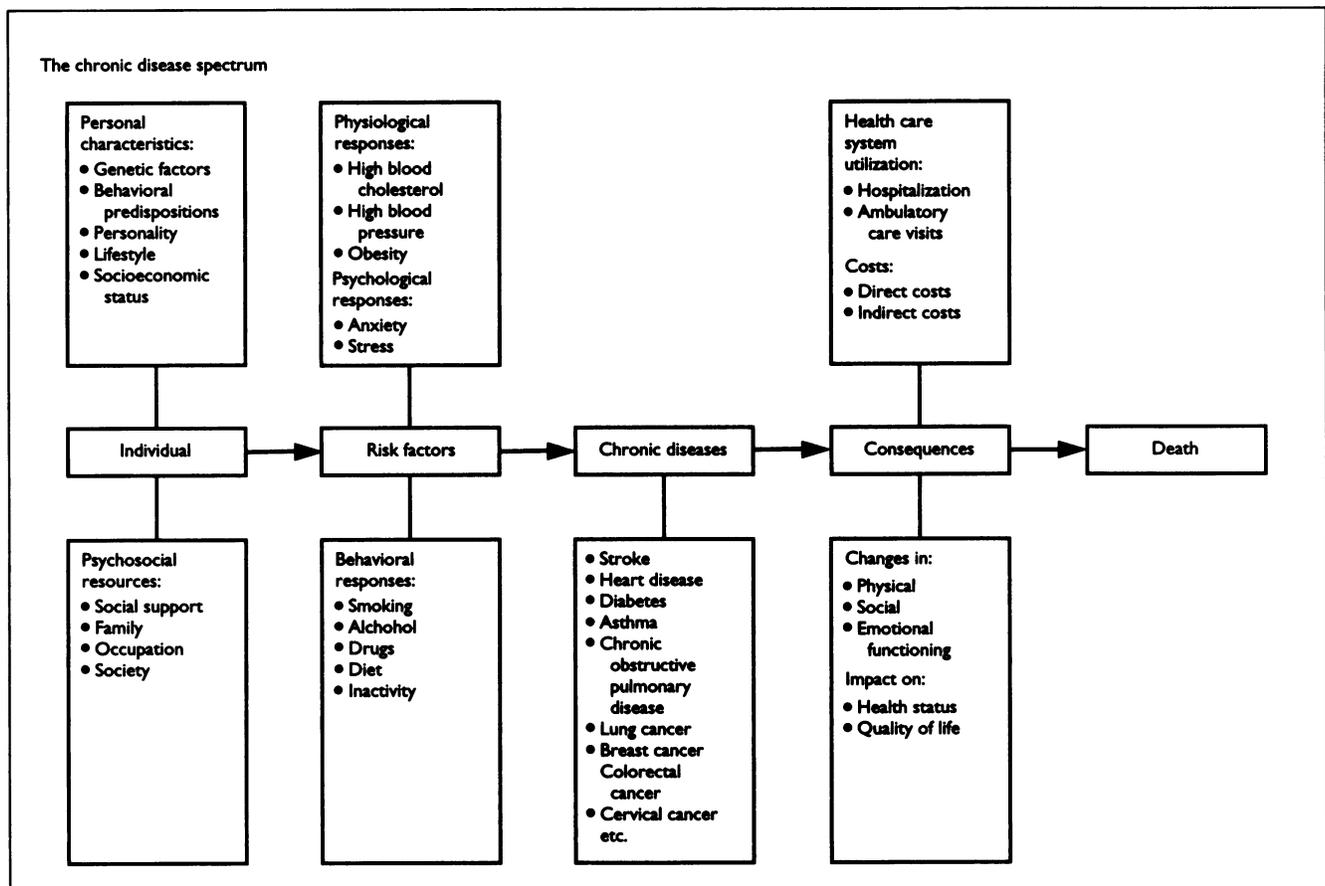
For many diseases, systematic, routinely collected, reliable data that pro-

vide measures for these concerns simply do not exist. Surveillance must rely on a combination of data sources. One of the goals prompting development of DIAS was to bring together key elements from a variety of sources to depict, to the fullest extent possible, the burden for selected chronic diseases. These sources vary from disease to disease and include the National Hospital Discharge Survey, the Surveillance, Epidemiology, and End Results (SEER) data, the National Health Interview Survey, the Vital and Health Statistics records, and the National Ambulatory Medical Care Survey.

From these sources, as well as others in the literature, we were able to summarize key information for each disease by 5-year age group and sex on eight dimensions of burden:

Morbidity:

- persons with condition (expected)
- new cases per year (expected)



**Mortality:**

- deaths per year (expected)
- indirect mortality costs (expected)

**Health care system utilization:**

- physician visits per year (expected)
- hospital discharges per year (expected)
- hospital days per year (expected)
- direct health care costs per year (expected)

Thus, for each disease, three fact sheets were created—one for males, one for females, and one for both sexes—that contain national estimates of these eight dimensions of burden broken down by 5-year age groups. Ideally, this information should be available also by race. Although the current version of the system does not include such a level of specificity, the DIAS system is designed to receive such information in the future. Table 1 is a fact sheet for coronary heart disease for women.

Finally, the system includes information on the risk factors known to be

associated with these diseases, their prevalence at the national level, and the corresponding relative risks for developing chronic diseases. Major sources of prevalence information are the National Health Interview Survey, the Behavioral Risk Factor Surveillance System, the second National Health and Nutrition Examination Survey, and the Alcohol Epidemiologic Data System. The sources of relative risks information are diverse; these are summarized in the Chronic Disease Reports published by CDC in the Morbidity and Mortality Weekly Reports (6-14). Relative risks of all risk factors for all nine chronic diseases are included in the system. Table 2 shows the relative risk of these factors for coronary heart disease.

**The Disease Impact Assessment System**

DIAS is a Lotus-based microcomputer program that brings together in

one system the information on the disease burden for nine major chronic diseases and their associated risk factors. The nine diseases and their ICD-9 codes are listed in table 3.

This information enables a user to estimate quickly the burden of these diseases in terms of the eight dimensions of burden listed previously for any specific population of interest. Furthermore, the system also estimates the proportion of the disease burden in the population attributable to the risk factors associated with that disease (table 2). The user is only required to enter the population of interest by sex and 5-year age group.

The system applies the national estimates gathered in the fact sheets to the population entered by the user. The program calculates the burden of the nine diseases in terms of the burden dimensions mentioned previously and calculates the proportion of that burden, as well as the actual numbers, that can be attributed to risk factors. The user

**Table 1. Coronary heart disease fact sheet for women from the Disease Impact Assessment System (DIAS)**

Age	Incidence <sup>1</sup>	Prevalence <sup>1</sup>	Mortality rate <sup>2</sup>	Ambulatory visits <sup>3</sup>	Hospital discharges <sup>4</sup>	Length of stay <sup>4</sup>
<5.....	0.0	0.0	0.2	0.0	0.0	3
5-9.....	0.0	0.0	0.0	0.0	0.0	0
0-14.....	0.0	0.0	0.0	0.0	0.0	0
15-19.....	0.3	0.0	0.1	0.0	0.0	0
20-24.....	0.4	1.3	0.2	0.0	0.1	3
25-29.....	0.5	1.2	1.3	1.8	0.1	6
30-34.....	0.7	1.2	1.3	1.8	0.2	4
35-39.....	0.9	9.0	8.0	1.8	1.1	4
40-44.....	5.1	9.0	8.0	1.8	1.2	4
45-49.....	6.5	9.0	41.6	32.2	4.1	6
50-54.....	8.0	9.0	41.6	32.2	5.0	6
55-59.....	8.6	50.1	165.9	32.2	10.6	6
60-64.....	8.5	50.1	165.9	32.2	10.2	6
65-69.....	11.2	76.3	509.7	75.3	17.1	6
70-74.....	14.1	76.3	509.7	75.3	20.7	6
75-79.....	18.4	43.3	1,610.5	83.0	29.2	8
80-84.....	28.8	43.3	1,610.5	83.0	29.2	8
85+.....	37.2	43.3	5,191.1	83.0	29.2	8

<sup>1</sup>Rate per 1,000. From the American Heart Association "Heart and Stroke Facts, 1990" (17).

<sup>2</sup>Rate per 100,000. From the Centers for Disease Control, WONDER Database (18).

<sup>3</sup>Rate per 1,000. From the National Ambulatory Medical Care Survey, 1989, National Center for Health Statistics, April 1992 (19).

<sup>4</sup>From the National Hospital Discharge Survey, 1988-90, Centers for Disease Control, WONDER Database (18).

**Table 2. Risk factors and coronary heart disease: relative risks, population attributable risks, and attributable deaths in Wisconsin**

Risk factor	Risk factor prevalence in the U.S. <sup>1</sup>	Relative risk <sup>1</sup>	Population attributable risk <sup>1</sup>	Estimate of attributable deaths in Wisconsin <sup>2</sup>
	percent		percent	
<b>Hypertension:</b>				
140–159 mm Hg.....	12.0	1.7	5.8	742
More than 159 mm Hg.....	17.7	2.8	23.0	2,944
<b>Male smokers:</b>				
Former.....	28.9	1.4	8.4	543
Current.....	31.2	1.9	20.8	1,344
<b>Female smokers:</b>				
Former.....	17.4	1.3	4.3	270
Current.....	26.5	1.8	16.4	1,034
<b>Diabetes:</b>				
Male.....	5.7	2.1	5.6	365
Female.....	7.4	4.7	21.6	1,361
<b>Cholesterol:</b>				
200–239 mg per dL.....	30.3	1.7	12.9	1,642
More than 239 mg per dL.....	26.7	3.0	29.8	3,812
High density lipoprotein.....	11.2	2.4	13.5	1,721
Inactivity.....	58.8	1.9	34.6	4,421
<b>Overweight:</b>				
110–129 MRW.....	41.4	1.5	14.1	1,795
More than 129 MRW.....	26.6	2.0	18.1	2,307

<sup>1</sup>Reference 11.

<sup>2</sup>Obtained using the Disease Impact Assessment System and the 1990 Wisconsin census. Because persons may be exposed to more than one risk factor, estimated deaths from more than one risk factor should not be added.

NOTE: Mg per dL = milligrams per deciliter; MRW = median relative weight.

can then browse through and print the summary results. Results can be summarized by disease or by dimension.

### Test of the System

To test the system and its underlying model, we entered the 1990 population of Wisconsin and used the national data in the fact sheets to generate State-specific chronic disease burden estimates. For example, table 2 shows the number of coronary heart disease deaths that can be attributed to hypertension, smoking, diabetes, high blood cholesterol, inactivity, and overweight.

Table 3 shows the expected number of incident cases of eight of the chronic diseases (national estimates

of asthma incidence were not available). Although an approximation, these results permit the user to com-

pare the relative contribution of each disease to the overall health burden in the population.

Finally, we compared the burden estimates using DIAS with independent sources for Wisconsin for four burden dimensions: mortality, incidence, hospitalizations, and ambulatory care visits (15).

Since DIAS parameters are based on national studies, we would expect that the estimates for Wisconsin would be similar, but not exact. Furthermore, the data collection years in the national estimates used in DIAS, the data collection years of the independent Wisconsin sources, and the population year do not coincide exactly. Results are shown in table 4.

In general, the estimates from DIAS are very similar to the estimates obtained from selected data systems in the State. Differences observed between the DIAS estimates and the actual data for Wisconsin may have several causes. First, the actual disease rates may be different in Wisconsin. For example, Wisconsin has a lower rate of lung cancer mortality than the United States. Second, there may be differences in the disease definitions. For example, the DIAS estimates for cervical cancer include only invasive cancer, whereas the data published for Wisconsin included in situ cancer.

In addition, there are substantial

**Table 3. Expected number of new cases for men and women, Wisconsin**

Chronic disease and ICD-9 codes	Men	Women	Total
Asthma, 493.....	NA	NA	NA
Stroke, 430–434,436–438.....	5,680	4,592	10,272
Coronary heart disease, 410–414,429.2.....	27,459	12,093	39,552
Chronic lung disease, 491,492,496.....	NA	NA	NA
Diabetes, 250.....	5,941	7,446	13,388
Breast cancer, 174.....	...	3,099	3,099
Cervical cancer, 180.....	...	248	248
Colorectal cancer, 153–154.....	1,534	1,507	3,041
Lung cancer, 162.....	2,059	1,107	3,166

<sup>1</sup>Obtained using the Disease Impact Assessment System (DIAS) and the 1990 Wisconsin census.

NOTE: NA = Not available.

**Table 4. Wisconsin data compared with estimates using the Disease Impact Assessment System (DIAS) for four dimensions of the disease burden**

Dimensions	Wisconsin data <sup>1</sup>	DIAS estimates <sup>2</sup>
<i>Mortality</i>		
Stroke.....	3,383	3,553
Coronary heart disease.....	11,493	12,776
Diabetes.....	786	896
Lung cancer.....	2,424	2,661
Breast cancer.....	914	841
Cervical cancer.....	79	92
Colorectal cancer.....	1,280	1,264
<i>Incidence</i>		
Stroke.....	NA	10,272
Coronary heart disease.....	NA	39,552
Diabetes.....	NA	13,388
Lung cancer.....	2,427	3,166
Breast cancer.....	3,163	3,099
Cervical cancer.....	852	248
Colorectal cancer.....	2,741	3,041
<i>Hospitalizations</i>		
Stroke.....	15,370	12,694
Coronary heart disease.....	32,284	29,258
Diabetes.....	5,987	8,186
Lung cancer.....	2,645	4,102
Breast cancer.....	3,159	3,110
Cervical cancer.....	1,582	575
Colorectal cancer.....	3,063	3,208
<i>Ambulatory care visits</i>		
Asthma.....	356,000	325,411
Stroke.....	38,300	98,484
Coronary heart disease.....	207,500	117,541
Diabetes.....	356,000	259,642
Lung cancer.....	32,415	65,204
Breast cancer.....	81,029	40,205
Cervical cancer.....	NA	2,971
Colorectal cancer.....	71,885	65,204

<sup>1</sup>Obtained from existing data sources (15).

<sup>2</sup>Obtained using DIAS and the 1990 Wisconsin census.

NOTE: NA = Not available.

differences between the estimates of ambulatory care visits in Wisconsin versus the nation. Some of these differences can be attributed to actual differences in the disease prevalence and practice patterns. However, these ambulatory care data were obtained from a survey of health care providers. Although a similar questionnaire was

used in each survey, there may have been differences in the sampling methods or the type of physician responding to the survey. Therefore, ambulatory care data may not be as reliable as vital statistics or complete hospital discharge data when comparing the disease burden with the nation's.

Although there are differences, the

results nevertheless indicate that the model provides fairly reliable estimates of key components of the burden of the nine chronic diseases in the population. In fact, for several diseases, DIAS provides an estimate of the burden where no local data currently exist. For example, based on national data, an estimated 10,272 persons suffer a stroke each year in Wisconsin.

## Conclusion

Over the past decade, the Smoking Attributable Morbidity, Mortality, and Economic Cost (SAMMEC) software program has provided detailed estimates of the health and economic burden from smoking (16). These estimates have been extremely useful in demonstrating the magnitude of the burden from tobacco. Building on this model, DIAS can provide an overall estimate of the health and economic burden from common behavioral risk factors and the associated chronic diseases.

By simply entering census information into the Lotus-1-2-3-based program, public health professionals can obtain a broad estimate of the chronic disease burden in their community. Clearly, it would be preferable to use local data, if they exist. For example, every community should have access to local mortality data, and many communities now have cancer incidence and hospital discharge data (17). However, few communities have data on disease prevalence and on the contribution of risk factors to the major chronic diseases. In these instances, the information generated using national estimates can serve an important purpose.

Local surveillance data, combined with the information generated by DIAS, are directly useful for setting priorities for public health programs, assessing the impact of risk factors, and suggesting preventive measures for intervention directed at the public. In addition, just as the information

from SAMMEC has been used to emphasize the magnitude of the health and economic impact from smoking, the information from DIAS can be used to impress local policy makers with the health and economic impact of other risk factors and chronic diseases.

Because public health practitioners have different needs, DIAS is designed in such a way that the user can modify estimates in the program, such as the prevalence of risk factors. This capability is extremely useful since it enables the user to create a series of what-if scenarios regarding the potential impact of interventions, such as a smoking control program. By decreasing the prevalence of that risk factor and running the program again, the user can directly observe the impact of such a strategy on the overall burden of these diseases. For example, DIAS allowed us to estimate that a successful smoking control program aimed at current smokers in Wisconsin, that will effectively decrease the prevalence of current smokers by 5 percent (but increase the prevalence of former smokers by 5 percent) would, across the nine chronic diseases examined, save 329 lives and avoid 1,216 new cases of diseases attributable to smoking on average per year.

Over time, DIAS can be expanded to include more recent data, as well as address other diseases. Future additions to the system will include quality-related outcome measures and modeling capabilities to summarize the eight dimensions of the disease burden into a composite score so as to provide a better basis for rational priority setting under conditions of scarce resources.

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This study was funded in part through cooperative agreement No. U58/CCU503346-01 with the Centers for Disease Control and Prevention. A copy of the Disease Impact Assessment System is available for \$25 from Dr. Sainfort, University of Wisconsin Department of Industrial Engineering, Room 396, Madison, WI 53706; tel. 608-263-3610; FAX 608-262-8454.

*Tearsheet requests to Patrick L. Remington, MD, MPH, Wisconsin Division of Health, 1414 East Washington Ave., Room 251, Madison, WI 53703 tel: 608-267-3835; FAX: 608-266-8925.*

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